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Spatial Distortion in Perception and Cognition

An inaugural lecture to celebrate Birkbeck professional promotion was given by Matthew R Longo of the college's Department of Psychological Sciences.

This post was contributed by Elena Azañón and Luigi Tamè, postdoctoral fellows in Birkbeck's BodyLab

Prof Matthew Longo gave his inaugural lecture about "Spatial Distortions in Perception and Cognition" on June 4th. He has been a lecturer in the Department of Psychological Sciences at Birkbeck, University of London, since 2010, and has recently been appointed Professor of Cognitive Neuroscience in the same Department.

He completed his PhD at the University of Chicago in 2006 and spent several years at the Institute of Cognitive Neuroscience at University College London as a postdoctoral researcher before joining Birkbeck. The main focus of his research concerns the psychological and neural mechanisms underlying body representations, and how these affect all aspects of our mental lives.

Longo's inaugural lecture was introduced by the Master of Birkbeck, Prof David S Latchman, who commented on Longo's exceptional achievements during his remarkable career. Professor Latchman highlighted the high quality of his research and impressive publication record in high impact journals. Indeed, Longo has been recently awarded by two of the major internationally recognised early career awards, in Europe (i.e., the 2014 Experimental Psychology Society Prize) and overseas (i.e., the American Psychological Association Distinguished Scientific Award for Early Career).

Pathological conditions

Longo started his lecture by highlighting that in many situations healthy people appear to have distorted representations of their bodies. However, despite these distortions, people are able to appropriately interact with the environment. Longo continued by describing several bizarre pathological conditions characterised by distortions in the representations of the body.

The underlying idea is that pathology is a continuum and, in one way or another, healthy people might share some features of these deficits. One of the paradigmatic examples he mentioned was the phantom limb experience, a condition in which a patient who has suffered the amputation of a limb, continues to experience the limb. In this respect, he recounted an elegant historical anecdote about Horatio Nelson's phantom limb experience after loss of his arm, which was described by the admiral as proof of the immaterial soul.

He finally mentioned a patient, described by Oliver Sacks, who repeatedly fell out of her bed. When asked the reason of this behaviour, the patient complained that the nurses were secretly introducing a severed arm in the bed with her. The nurses finally realized that the patient was affected by somatoparaphrenia (i.e., the lack of awareness of a part of the body). It was the patient's own left arm, which she believed was somebody else's arm that she was throwing out of the bed!

Spatial distortions in perception

Before starting to describe his own work, he explained more about the idea of spatial distortions in perception. This is somehow a counterintuitive concept considering that the goal of perception is to create a veridical model of the world.

If people perceive a distorted world, how can they possibly act on it in an appropriate way? As an example of normal distortions, he described the representations at the level of the primary sensory and motor cortices in which the body parts are represented with different levels of magnification. Longo

explained that these distortions are necessary steps to achieve complex behaviours.

Indeed, if we had homogenous tactile sensitivity across the body, then apparently simple tasks such as lacing up our shoes would be impossible. What allows us to perform everyday actions, which seem simple to us but are incredibly complex from a motor control perspective, is that different bits of the skin are represented differently in the brain. That is, bits of the skin able to produce fine-grained movements, such as the fingers, have extremely high tactile sensitivity, while others, such as the back of the leg have much less sensitivity.

Examining distortions

In the second half of the lecture he demonstrated that body representations are not only distorted at the level of the primary cortices, but also, though to a lesser degree, at higher levels of perceptual processing. Across several experiments, Longo made use of Weber's illusion. In this illusion, the perceived distance between two touches is larger on skin regions of high tactile sensitivity than on those with lower acuity. His research suggests that the dorsum of the hand, but not the palm, is implicitly represented wider and squatter than it actually is. He argued that these distortions are partly explained by the shape of the tactile receptive fields of cortical neurons on the different parts of the hand.

Longo continued describing similar distortions of the representation of our bodies that are independent from touch. In order to isolate and measure this implicit body representation, Longo developed, jointly with his former supervisor, Professor Patrick Haggard from UCL, an elegant, simple and effective paradigm.

Participants used a long baton to judge the location of the knuckle and tip of each finger of their own occluded hand. By comparing the relative location of each landmark, he was able to construct implicit maps of the represented shape

and size of the hand, which could then be compared to the actual hand shape. He found that these maps were drastically distorted, and in a highly consistent manner across individuals. In particular, across a number of studies, Longo revealed a general underestimation of finger length and an overestimation of hand width. These distortions are similar to those he found in the tactile modality. He further noted that this pattern of results was highly stable across body parts.

The event concluded with a final speech by Professor Martin Eimer. He thanked Longo for his exciting and entertaining lecture. He further highlighted the high productivity and creativity of Longo's research during his early career, exalting the elegance of his experimental approach and design. He also highlighted that despite being a great scientist, he is likewise an excellent colleague, who is always available and willing to perform mundane duties that despite being unexciting, are fundamental for the department's life.